DIGITAL CAMERA, MOBILE TERMINAL, AND METHOD OF DISPLAYING IMAGES

FIELD OF THE INVENTION

The present invention relates to a digital camera capable of displaying a monitor image. More particularly, this invention relates to a digital camera capable of displaying image data (or datum) stored in a recording medium.

BACKGROUND OF THE INVENTION

Conventionally, in digital cameras, image data picked-up with an inbuilt photographing section is displayed on a monitor at a recording mode when an image datum is stored(recorded) in a recording medium. The digital camera displays an image so that the mode when an image datum recorded in the recorded medium is changed over to a reproduction mode. Further, a photographer depends on his/her own sense in such a conventional digital camera when obtaining each of image data in order to combine a plurality of image data after photographing. When combining the image data after photographed by the digital camera, whose object has already been stored in a recording device, the image data will be transferred to a personal computer (hereinafter, referred as "PC") thereby combining the image data with PC.

However, following steps are required in such a conventional digital camera when combining image data. Namely, after an object is photographed and recorded, the image data are transferred from the digital camera to a computer or a personal computer (PC), and the image data are combined. Therefore, it is not easy to obtain desired combined image data. Additionally, a troublesome operation will occur.

SUMMARY OF THE INVENTION

It is an object of the present invention is to provide a digital camera capable of obtaining a desired combined image data the need of the PC. It is an another object of this invention is to provide a digital camera capable of obtaining a desired combined image data by a single photographing operation without the need of the PC.

The digital camera according to one aspect of this invention has a photographing unit which photographs an image to obtain image data, a storage control unit which stores the image data as an image data file in a predetermined manner, a reconstruction control unit which reconstructs the image data stored in the recording medium, an image data processing unit which combining the image data obtained by the photographing unit with the image data reconstructed by the reconstruction control unit to produce image data and stores the produced image data into the recording medium, a display

control unit which makes a display device display the image data obtained by the photographing unit for monitoring and simultaneously has the image data from the reconstruction control unit displayed on the display device or which makes the display device display the image data obtained by the image data processing unit, and an operational instruction input unit which provides an operational instruction signal to the photographing unit, the storage control unit, the image data processing unit, and the display control unit.

The digital camera according to another aspect of this invention a photographing unit which picks-up an image and obtain image data, a storage control unit which stores the image data as an image data file in a predetermined manner, a reconstruction control unit which reconstructs the image data stored in the recording medium, an image data processing unit which combines the image data obtained by the photographing unit with the image data reconstructed by the reconstruction control unit to produce image data and stores the produced image data into the recording medium, a display control unit which makes a display device display the image data obtained by the photographing unit for monitoring and simultaneously has the image data from the reconstruction control unit displayed on the display device or which makes the display device display the image data processed by the image data processing unit, and an operational instruction

input unit which provides an operational instruction signal to the photographing unit, the storage control unit, the image data processing unit, and the display control unit. In this digital camera, the photographing unit has a plurality of CCDs and can simultaneously pick-up images of a plurality of objects. Furthermore, the display control unit can make the display device simultaneously display the plurality of image data obtained by the photographing unit.

Other objects and features of this invention will become understood from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 shows a block diagram of a digital camera according to a first embodiment of the present invention.

Fig.2 shows construction of a CPU of the digital camera according to the first embodiment.

Fig.3 is for explaining how the digital camera of the first embodiment combines two image data and stores the image data.

Fig.4 shows a block diagram of a digital camera according to a second embodiment.

Fig.5 is for explaining how the digital camera of the second embodiment combines two image data and stores the image data.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be explained in detail below by referring to the accompanying drawings.

Fig.1 shows a block diagram of a digital camera according to a first embodiment of the present invention. This digital camera comprises lens 1, mechanical system 2 including auto focus device, CCD (charge-coupled device) 3, CDS (correlation duplication sampling) circuit 4, AD converter 5, digital signal processing circuit 6, CPU 7, ROM 8, RAM 9, memory card 10, LCD (display apparatus) 11, compression and expansion circuit 12, driver 13, control signal generation unit ("SG") unit 14, operation unit 15, touch panel interface 17, image display control circuit 18, image display memory 19 and the like.

The CCD 3 receives light from an object through the lens 1. The CDS circuit 4 is connected to the CCD 3. The AD converter 5 is connected to the CDS circuit 4. The digital signal processing circuit 6 is connected to the AD converter 5. The CPU 7 is connected to the digital signal processing circuit 6, ROM 8, RAM 9, memory card (memory medium) 10, compression and expansion circuit 12, touch panel interface16, and image display control circuit 18 by way of bus 20. Further, the CPU7 is connected to the driver

13, SG unit 14, and operation unit 15. The image display memory 19 is connected to the digital signal processing circuit 6 and the image display control circuit 18. The LCD 11 is connected to the image display control circuit 18. The touch panel 17 is connected to the bus 20 in way of the touch panel interface 16.

Mechanical system 2 including the lens 1, not shown auto focus apparatus, stop member, and filter unit constitutes the lens unit 101. The driver 13 controls the lens unit 101 based on a control signal supplied from the CPU 7. The CCD 3 converts the image light inputted through the lens unit 101 to an electric signal (an analog image datum). The lens unit 101 and the CCD3 constitutes photographing section 102 which picks-up image data. The CDS circuit 4 is for eliminating noise of image data from the CCD 3. Further, the AD converter 5 converts the analog image data input from the CCD3 by way of the CDS circuit 4 to digital image data.

Namely, analog image data from the CCD 3 are converted into digital image data at an optimum sampling frequency (e.g., a sub-carrier frequency of NTSC signal multiplied by an integral number) by the AD converter 5 by way of the CDS circuit 4. The SG unit 14 generates a control signal to be used in the CCD 3, CDS circuit 4, and AD converter 5 based on a control signal supplied from the CPU 7. The

SG unit 14 provides this signal to the CCD 3, CDS circuit 4, and AD converter 5. Further, the digital signal processing circuit 6 divides the image data inputted from AD converter 5 into color difference data and luminance data to perform various processes, i.e. perform data process such as correction, compression or expansion of an image.

The image compression and expansion circuit 12 performs processing such as orthogonal transformation, inverse orthogonal transformation. These processing are image compression and expansion in conformity with the JPEG. The compression and expansion circuit 12 performs Huffman coding/decoding and the like. These processing are image compression and expansion in conformity with the JPEG. The ROM 8 stores a control program to be used by the CPU 7. The RAM 9 temporarily stores the image data to be used by the CPU 7.

The memory card 10 stores image data compressed by the image compression and expansion circuit 12 in the form of a data file. The image display control circuit 18 makes the LCD 17 display an image for monitoring ("monitor image") a reconstructed image. The image display control circuit 18 makes the LCD 17 display the monitor image and the reconstructed image. The image display control circuit18 makes the LCD17 display a state of digital camera in which a monitor image is adapted such as a mode display and an

error display having already been set.

The operation unit 15 is provided with button/s for inputting various parameters or information. The input may include selection of functions, start or end of photographing. The touch panel 16 outputs a portion of coordinates which is touched with a touch pen or the like. The operation unit 15 and the touch panel 16 constitute the operational instruction inputting section 103 which inputs various operational instruction signals.

Fig.2 shows a block diagram of construction of the CPU 7. The CPU 7 is at least provides with the storage control unit 104, reconstruction control unit 105, image data processing unit 106, and display control unit 107. The storage control unit 104, reconstruction control unit 105, image data processing unit 106, and display control unit 107 are connected to the digital signal processing circuit 6, ROM 8, RAM 9, memory card 10, compression and expansion circuit 12, touch panel interface 16 and image display control circuit 18 by way of bus 20.

The storage control unit 104 stores the image data obtained by the photographing section 102 in a predetermined manner in the form of a data file. The reconstruction control unit 105 controls reconstruction operation of image data file stored in the memory card 10 to reconstruct image data. The image data processing unit 106 combines the image data

picked-up by the photographing section 102 with image data reconstructed by the reconstruction control unit 105 and produces image data to have image data stored into memory card 10. The image data processing unit 106 also combines a plurality of image data stored in memory card10 to produce image data to have image data stored into memory card 10. The display control unit 107 makes image data obtained by the photographing section 102 and image data reconstructed by the reconstruction control unit 105 display onto the LCD 11. Alternatively, display control unit 107 makes an image datum from image data processing unit 106 display onto the LCD 11. The image data processing unit 106 can perform swing and/or tilt correction or color correction when combining image data which have already been stored in memory card 10.

The CPU 7 executes operations of storage control unit 104, reconstruction control unit 105, image data processing unit 106, and display control unit 107 corresponding to various operational instruction signal from operational instruction inputting section 103.

The operational instruction inputting section 103 can designate a portion where image data are to be displayed in a combined manner. In response to this designation, the image data processing unit 106 combines a plurality of image data to make the data stored in the memory card 10. The

The digital image data from AD converter 5 is signal-processed by the digital signal processing circuit 6. The signal-processed image data are written into the plane P1 of image display memory 19. The written data are displayed on the LCD 11. Monitor display on the LCD 11 is renewed at a predetermined interval. The display may be renewed for example fifteen frames per second.

If a photographer pushes a release, a single image data are stored in the RAM 9 by way of the CPU 7 and bus 20. Image data stored in the RAM 9 are written onto the plane P2 of the image display memory 19 by way of the image display control circuit 18. As a result, a first obtained still image is displayed on the LCD 11. Thereby operational instruction is written into the plane P3 thereafter performing overlapping and performing display operation. Next, the photographer provides instructions as to the second combined position (connection position), operating the touch panel 16. In response to this instructions, display control unit 107 moves a display portion of the plane P2 corresponding to the instructions.

If monitor operation is restarted, a portion of a first image data and the image data displayed on the monitor are combined resulting in displaying the combined image on the LCD 11. The photographer confirms a connection portion in the first image data and photographs an image, watching the

monitor image of the second image. If the release button is pressed, the second image data is stored in the RAM 9 by way of the CPU 7, and bus 20.

Two image data are combined (connected) in the RAM 9. The combined image is input as a single image to the compression and expansion circuit 12 for compression. The compressed image is stored into the RAM 9. The image data processing unit 106 can perform color correction, such as γ-correction, brightness, contrast, and hue, when combining two or more image. The image data processing unit 106 can also perform correction of deformation of image such as correction owing to swing and/or tilt, inclination, and distortion. When compression by the compression and expansion circuit 12 is completed, the CPU 7 transfers the compressed image data from the RAM 9 to the memory card 10 by way of the bus 20 to be stored in a predetermined manner.

Digital camera according to the second embodiment will be explained with reference to Fig. 4 and Fig. 5. Fig.4 shows a block diagram of the digital camera according to the second embodiment. Fig.5 is for explaining how the digital camera of the second embodiment combines two image data and stores the image data. The sections in Fig. 4 that perform same or similar functions as the sections shown in Fig. 1 are provided with same reference numerals and, to avoid repetition, their explanation is omitted.

The digital camera according to the second embodiment includes following sections in addition to the sections of the digital camera according to the first embodiment. That is, this digital camera additionally includes lens 1, mechanical system 2 including auto focus system, CCD 3, CDS circuit 4, AD converter 5, digital signal processing circuit 6, driver 13, and SG unit 14. Namely, this digital camera is provided with two lenses 1, two mechanical systems 2, two CCDs 3, two CDS circuits 4, two AD converters 5, two digital signal processing circuits 6, two drivers 13, and two SG units 14. This digital camera also includes CPU 7, ROM 8, RAM 9, memory card 10, LCD 11, compression and expansion circuit 12, operation unit 15, touch panel interface 16, touch panel 17, image display control circuit 18, and image display memory 19. The CPU 7 in the second embodiment has the same structure as the CPU 7 in the first embodiment except for it can simultaneously process two images.

The lens units 101 can be moved independently. A photographing direction can be adjusted therebetween. Image information obtained from each lens unit 101 is separately processed by corresponding digital signal processing circuit 6. The processed image information are written into plane P1 and plane P2 in image display memory 19.

The LCD 11 displays image data from both of CCDs 3

for monitoring. An overlapping position with relative to display positions of planes P1 and P2 are controlled. The image data thereof are combiningly imaged. Then, an overlapping position corresponds to the display positions of planes P1 and P2, so that two image data combination can be performed at the time of monitoring the image data. Each digital signal processing circuit 6 performs digital signal processing independently to the corresponding image data, so that color correction can be performed independently therewith, too. Each digital signal processing circuit 6 can independently set zooming ratio, shutter speed, exposure correction, and white balance or the like for the corresponding image data.

If the photographer presses the release button, the image data are stored into the RAM 9 from both of the digital signal processing circuits 6. Data obtained in RAM 9 can be stored in the form of independent image files in the memory card 10. After obtaining two image data, connection therebetween as above-mentioned process is performed, and a single image file thereby can be stored.

Optionally, when the display control unit 107 makes the LCD 11 simultaneously display a plurality of the image data picked-up by the photographing section 102 for monitoring, the image data processing unit 106 can combine a plurality of image data. Further, image data processing

unit 106 can perform color correction with respect to each image data. Furthermore, the image photographing sections 102 can simultaneously obtain images of the same object at different zooming ratios. Furthermore, the image photographing sections 102 can simultaneously obtain images of the same object at different exposure.

The digital camera according to the two embodiments described above may be incorporated in a mobile terminal such as PAM.

Thus, according to the present invention, image data picked-up by the photographing unit and the image data reconstructed by the reconstruction control unit are displayed on the display device, or image data processed by the image data processing unit are displayed on the display device. As a result, a desired number of images can be combined easily without the need of the personal computer.

Furthermore, the photographing unit includes a plurality of CCDs. Thereby the photographing unit can pick-up a plurality of images of the same or different objects. Furthermore, the display control unit simultaneously makes the display device display the plurality of images of the same or different objects. Also, the image data processing unit can combine the plurality of image data. As a result, a desired number of images can be combined easily without the need of the personal computer.

The present document incorporates by reference the entire contents of Japanese priority document, 2000-121837 filed in Japan on April 21, 2000.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.